TUMORS OF THE LUNG*

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TUMORS of the lung are of great clinical importance because of their frequency and serious significance. With few exceptions primary pulmonary tumors arise from the wall of a bronchus. Whenever the lumen of one of the larger bronchi is encroached upon by a tumor mass, the endobronchial obstruction may result in secondary pulmonary inflammation with pneumonitis, bronchiectasis and abscess formation. Most pulmonary tumors are malignant, but even small benign tumors may prove serious because of secondary infection. Pneumonitis is not infrequently the presenting feature of the clinical picture. Hence the primary underlying tumor may go unrecognized for varying periods of time.

Little can be said concerning the etiology of most pulmonary tumors. The frequency with which malignant tumors develop in an area of chronic pulmonary infection such as bronchiectasis is not sufficient to warrant the assumption of a cause and effect relationship. With respect to the increase in the incidence of carcinoma of the lung, this seems greater than can be accounted for by improved methods of diagnosis. It is possible that the present day heavy cigaret smoking may be related to the prevalence of pulmonary cancer.

Benign Endobronchial Tumors. Benign tumors which arise from the bronchial wall and project into the lumen of the bronchus are rare. Such a benign tumor, derived from one or more of the component tissues of the bronchus, may be a polyp, fibroma, lipoma, chondroma, leiomyoma, osteoma or lymphoma. Adenomas should be considered as a separate group because of their tendency to extrabronchial invasion. The benign endobronchial tumors may cause cough and wheezing but frequently the chief symptoms are due to secondary pulmonary suppuration caused by bronchial obstruction. The diagnosis is established by bronchoscopy and biopsy unless the tumor is in a small branch

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bronchus. Endoscopic removal may result in cure if the treatment is instituted before distal suppuration has produced bronchiectasis. Otherwise lobectomy or pneumonectomy is indicated to remove the infected pulmonary tissue.

Malignant Adenoma and Cylindroma. Adenomas of the bronchus have been described under a variety of names, such as benign adenoma, malignant adenoma, mixed tumor of the bronchus, adenocarcinoma, hemangioendothelioma, etc. They constitute less than five per cent of all pulmonary neoplasms but are of considerable importance. The results which may be attained by correct diagnosis and proper treatment are excellent. Adenomas frequently show evidence of local invasion. The regional lymph nodes are occasionally involved by direct extension but only rarely without evidence of direct continuity with the main tumor. Diffuse metastasis from an adenoma of the bronchus which has not undergone obvious malignant change rarely, if ever, occurs. A very few cases with isolated metastases as chance findings at autopsy have been reported. There are a small number of cases on record in which a typical adenoma proven by biopsy was found to have years later the characteristics, both pathologically and clinically, of carcinoma of the lung with metastases. It seems best, therefore, to designate these adenomas as malignant adenomas, recognizing that usually they remain localized and grow slowly over a period of many years, but that occasionally they undergo malignant change and metastasize. The prognosis of malignant adenoma as contrasted with the epidermoid and adenocarcinoma of the lung is so different that failure to consider these two groups separately leads to an inaccurate evaluation of the results of surgical or radiation treatment of carcinoma of the lung.

The term cylindroma has been applied to a tumor which has many of the characteristics of a bronchial adenoma but which, upon microscopic examination, reveals cylinders of cells enclosing either a mucous or hyaline material. Cylindromas of the bronchus not infrequently extend up to the carina or project into the trachea. In approximately one-half of the reported cases the cylindroma either extended to the trachea secondarily or arose from the tracheal wall. Such a finding is far less common with adenomas. Cylindromas also have a greater tendency to local invasion and to metastasis than adenomas. For these reasons they are considered as a separate group of tumors, although in some instances portions of the same tumor may show both adenomatous

and cylindromatous characteristics.

Adenomas and cylindromas occur more frequently in females, in marked contrast to carcinoma of the lung. The majority of cases are encountered between the ages of 20 and 40 years but all age groups may be affected. The symptoms of adenoma and cylindroma may be caused by either the tumor itself or by the secondary suppurative process. Because these tumors are usually located in the larger bronchi, pulmonary suppuration with bronchiectasis and abscess formation occurs in the majority of cases. Empyema occurs occasionally. The symptoms due to the tumor itself are wheezing, hemoptysis and cough. Transient pain is sometimes present even in the absence of infection. When secondary suppuration develops as a result of bronchial obstruction, fever, productive cough, chest pain and other symptoms of pulmonary infection may be present. Some patients give a long history of wheezing and perhaps occasional hemoptysis. In other instances the patient considers himself perfectly well up to the time when a sudden onset of pulmonary infection, often diagnosed as pneumonia, intervenes. Failure of the pneumonic process to clear rapidly under chemotherapy, together with roentgen findings suggestive of chronic pulmonary changes with atelectasis should lead to a consideration of a possible underlying endobronchial tumor. Contrary to the statement usually made in the literature, adenomas may occur in smaller branch bronchi and in such instances may be largely asymptomatic because secondary infection is less common.

The physical findings vary greatly. Examination of the lungs is sometimes negative, but there may be localized wheezing or the physical findings of secondary suppuration and even secondary pleural involvement. Roentgen findings also vary greatly. The roentgenogram of the chest may be negative when there is a small adenoma in the main bronchus, but at this stage a respiratory shift of the mediastinum may sometimes be seen on fluoroscopy indicating partial obstruction to the ventilation of one lung. In some instances, especially if the adenoma arises from a smaller branch bronchus, a circumscribed tumor mass may be seen on the film. In many cases the roentgen findings may be those of secondary suppuration showing varying degrees of collapse of the lung and no direct evidence of the tumor itself. Planography may be of aid in demonstrating the endobronchial obstruction and may indicate the size of the extrabronchial portion of the tumor. Bronchoscopy will

usually establish the diagnosis of bronchial adenoma. The findings at this examination are often rather typical and the diagnosis can usually be confirmed by biopsy. Occasionally the adenoma arises from a branch bronchus not visible bronchoscopically. In such cases the tumor mass is seen on the roentgenogram.

Lobectomy or pneumonectomy is the treatment of choice in those cases of bronchial adenoma and cylindroma in which the patient's general condition is satisfactory. It is my policy at the present time to perform a lobectomy if the tumor can be completely removed by that procedure. Often total pneumonectomy is required because of the location of the growth. If the patient is toxic from secondary suppuration or if pleural complications are present, time should be spent in preparing the patient for radical surgery. Endoscopic removal of portions of the tumor may temporarily produce adequate bronchial drainage with diminution of the pulmonary infection. Because the tumors are vascular there is some danger of hemorrhage during endobronchial manipulation. If the patient's general condition is such as to increase considerably the risk of pulmonary resection, bronchoscopic removal of the endobronchial portion of the tumor may be of considerable benefit. In one of my cases of cylindroma there was a large extension into the trachea which responded temporarily to high voltage radiation. Approximately 90 per cent of my cases of adenoma and cylindroma are living, and all but a few are asymptomatic.

Circumscribed Benign Tumors of the Pulmonary Parenchyma. Included in this group are hamartoma, leiomyoma, lymphocytoma, neurofibroma and plasmocytoma. These tumors, with the execption of hamartomas, are very rare. They are often asymptomatic and may be a chance finding on roentgen examination. The exact diagnosis is established by pathological examination. It is rarely made clinically. Lobectomy is usually indicated. Hamartomas, often called chondromas, consist chiefly of cartilage but also contain cysts lined with bronchial epithelium. A hamartoma is very firm and may thus be confused with carcinoma at operation. Partial lobectomy is usually adequate treatment for a hamartoma.

Angiomas of the lung have been described. Hemoptysis may occur but the lesion may be asymptomatic. When the vascular spaces are large a rather free communication between the pulmonary artery and pulmonary vein may be established. Such cases have been designated

as cavernous hemangiomas or arteriovenous fistula of the lung. A large amount of blood may be shunted through the large vascular channels without the blood being oxygenated. Oxygen unsaturation of the arterial blood results. The patient may present cyanosis, clubbing of the fingers and toes, and polycythemia. A density in continuity with the pulmonary artery is seen on the roentgenogram. Angiocardiogram will confirm the diagnosis. Resection of the involved portion of the lung is indicated.

Carcinoma of the Lung. The clinical picture of carcinoma of the lung varies considerably, depending upon the topographical location of the tumor and its pathologic characteristics. In some cases a large carcinoma in the peripheral portion of the lung is a chance finding on roentgen examination at a time when the patient is asymptomatic and is at maximum weight. A small primary bronchogenic carcinoma may cause few symptoms; the metastatic lesion may be the presenting feature of the clinical picture.

When a bronchogenic carcinoma arises in the main bronchus or near one of the lobar branches, the patient may give a history of chronic cough, later productive of mucoid or blood-streaked sputum and occasional frank bleeding. Many patients, however, never have hemoptysis. There may be symptoms of secondary suppuration. A history of wheezing may often be elicited. Bronchoscopy and biopsy will usually yield a definite diagnosis in this group. When the tumor arises from a smaller branch bronchus in the mid lung field, cough and expectoration may be minimal until the tumor has attained considerable size. If no large bronchus is obstructed by the tumor mass, secondary suppuration may not develop distally, but the tumor itself may undergo central necrosis and liquifaction. When central necrosis of the tumor is marked, the lesion may be misinterpreted as a pulmonary abscess. By roentgenogram the tumor shows a thicker, more irregular wall than is usually found in an ordinary pyogenic abscess. Tumors in the mid-lung field cannot be visualized bronchoscopically, but aspiration biopsy or examination of the sputum or secretions aspirated at the time of bronchoscopy may demonstrate tumor cells.

When a bronchogenic carcinoma arises at the periphery of the lung, there may be little if any cough or expectoration, and blood spitting is usually absent. When such a tumor develops at the apex of the lung, pain in the shoulder region may be the presenting symptom, and the

patient may be erroneously treated for arthritis or other local pathology. An x-ray of the shoulder girdle may demonstrate the lesion in the apex of the lung. Sometimes this lesion is so small that it may be misinterpreted as apical pleural thickening due to old tuberculosis. These patients may have severe pain radiating into the neck and down the arm. Neurological signs, including a Horner's syndrome are present in some cases. When a peripheral carcinoma of the lung extends into the chest wall, a mass, often associated with localized pain, may be the presenting feature. An erroneous diagnosis of tumor or abscess of the chest wall may be made. A primary bronchogenic carcinoma arising in the paramediastinal portion of the lung may closely simulate a primary malignant mediastinal tumor. There may be swelling of the head, neck or upper extremities with venous engorgement, perhaps difficulty in breathing due to extrinsic tracheal or bronchial compression, and occasionally dysphagia from compression and partial invasion of the esophageal wall. Aspiration biopsy, properly performed, is of real value in the diagnosis of the peripherally located pulmonary carcinoma. Many of these lesions are obviously inoperable and exploratory thoracotomy may not be indicated. When a carcinoma of the lung is located near the lower posterior portion of the lower lobe, the symptoms may be referred to the upper abdomen, and upper abdominal pathology suspected. This is particularly true if the chest wall is involved. Occasionally a patient with carcinoma of the lung is suspected of having a primary brain tumor due to cerebral metastasis.

The early diagnosis of carcinoma of the lung is of paramount importance. As already indicated, the history is frequently not characteristic. With early lesions there may be few if any pulmonary symptoms. Hemoptysis is frequently absent. The importance of localized wheezing is not sufficiently stressed. Secondary infection may predominate in the clinical picture. Recurrent pneumonia or a pneumonia which does not respond to chemotherapy may be due to bronchial obstruction by tumor. Early diagnosis of pulmonary carcinoma depends largely on roentgen examination. The appearance of early lesions is frequently not characteristic and may readily be confused with other types of pathology. Any shadow on the roentgenogram which might be a pulmonary neoplasm calls for further investigation immediately.

The value of bronchoscopy in the diagnosis of early carcinoma of the lung has been overemphasized. The statistics from large broncho-

scopic clinics are misleading because the cases referred for endoscopy are obviously selected, and in many instances the neoplasm is seen on bronchoscopy only when the cancer is inoperable. Bronchoscopy establishes the diagnosis early only when the carcinoma arises in the main bronchus, at the orifice of the upper or middle lobe bronchus, or in the larger branches of the lower lobe bronchus. Carcinomas frequently arise more peripherally and therefore are not visible through the bronchoscope when the lesion is small. Aspiration biopsy is another method of diagnosis which deserves wider recognition. Properly performed, the risks and complications are few and the theoretical objections that have been advanced against the method are out-weighed by other considerations. Bronchoscopy, examination of the bronchial secretion or the sputum for tumor cells, and aspiration biopsy all have a place in diagnosis.

Exploratory thoracotomy is recommended in cases of suspected or proven carcinoma of the lung without evident distant metastases and provided the roentgenogram of the chest shows no conclusive evidence of mediastinal invasion. Some patients are rejected for surgery because of their general condition, advanced age and pulmonary emphysema. The most frequent cause for inoperability at the time of exploratory thoracotomy is direct extension of the tumor into the hilar structures.

Pneumonectomy is the treatment of choice in pulmonary carcinoma. Lobectomy is occasionally adequate. Resection of the lung can be performed, however, only in a small percentage of the cases because most patients have advanced disease when first seen by the surgeon. It must be realized that the favorable case of carcinoma of the lung is usually one in which the patient has few symptoms. In the last few years a considerable percentage of the cases that have been most satisfactory for resection have been chance findings on routine roentgen studies. This suggests that routine chest x-rays among the older age group, especially among males, might be a fruitful method of detecting early pulmonary neoplasms. If a lesion is discovered, valuable time should not be lost before initiating adequate therapy. Too often action is deferred in favor of a reëxamination at a later date.

Pneumonectomy is a relatively new operation. To date there have been only a few reports in which the five year arrests following resection for pulmonary cancer have been segregated from more recent cases. Consequently the summaries of some of the reports are mislead-

ing. The survival time following pneumonectomy is greatly influenced by the type of carcinoma resected. Even if malignant adenomas and cylindromas are not included, there is still a considerable variation in the malignant potentialities of different carcinomas of the lung. With few exceptions, our late good results have been observed in those patients in whom the tumor was of the slower growing type. In many clinics about 25 to 40 per cent of the patients in whom a diagnosis of carcinoma of the lung is made are subjected to exploratory thoracotomy. The percentage of the explored cases resected with a hope of cure has varied in different reports from about 25 to 45 per cent. The higher percentages are reported by individual surgeons and apply to selected material and consequently give a false impression of the actual situation in a general hospital. It is obvious, therefore, that pneumonectomy is feasible today in only a small percentage of patients with pulmonary cancer because of late diagnosis. The mortality from total pneumonectomy has decreased markedly in the past few years and is not at present a factor of major importance in large clinics. During the past four years my mortality for pneumonectomy in carcinoma of the lung has been less than five per cent.

There has been much controversy concerning the place of radiation therapy in the management of cancer of the lung. It must be realized that there are a variety of techniques in radiation therapy as there are in surgery. Radiation well localized to the tumor area lessens the unfavorable reaction from radiation pneumonitis. In some selected cases one may obtain real palliation.

Sarcoma of the Lung. Primary sarcoma of the lung is rare. Most of the pulmonary tumors reported as sarcomas several decades ago would be classified today as undifferentiated, small or oat-cell carcinoma. Clinically sarcoma of the lung simulates other pulmonary tumors, especially carcinoma. Occasionally the tumor extends into a bronchus and the diagnosis is established by bronchoscopic biopsy. Errors may occur in differentiating inflammatory tissue and sarcomatous lesions. The treatment of sarcoma of the lung is the same as indicated for carcinoma.

Lymphosarcoma and Hodgkin's Disease. Lymphosarcoma apparently primary in the lung is very rare, but the pulmonary tissue is often involved secondarily in cases of lymphosarcoma. Direct invasion from the mediastinum is frequent. Hodgkin's disease also may involve the pulmonary tissue. Extension through the wall of a bronchus is rare,

but extrinsic compression of the bronchus is not infrequent. Breakdown of the neoplastic tissue with resultant cavitation may occur. Lymphomatoid involvement of the lungs is preferably treated by radiation therapy.

Metastatic Tumors of the Lung. Pulmonary metastases are very common with a wide variety of neoplasms occurring in many primary sites. If the metastases to the lungs are obviously multiple, confusion with a primary carcinoma of the lung is uncommon because bronchogenic carcinoma rarely gives rise to multiple pulmonary metastases. A solitary metastasis in the lung, however, may be indistinguishable clinically from a primary pulmonary tumor. If a thorough clinical and roentgen investigation of other regions of the body fails to demonstrate a primary tumor elsewhere, the pulmonary tumor should be assumed to be primary and treated accordingly.

In rare instances lobectomy may be recommended for a metastatic tumor in the lung. It seems advisable to consider such therapy only if the primary lesion has apparently been eradicated and if the metastatic tumor is a slow-growing, solitary lesion appearing a long time after the primary tumor was removed.